October 28, 2005

10 CFR 54

U. S. Nuclear Regulatory Commission
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Palisades Nuclear Plant
Docket 50-255
License No. DPR-20

NMC Response to NRC Requests for Additional Information Dated September 28, 2005 Relating to License Renewal for the Palisades Nuclear Plant

In a letter dated September 28, 2005, the Nuclear Regulatory Commission (NRC) transmitted Requests for Additional Information (RAIs) regarding the License Renewal Application for the Palisades Nuclear Plant. Enclosure 1 provides the NMC responses to those requests.

In addition, in a letter dated August 19, 2005, NMC provided a preliminary response to RAI 4.3-15, and stated that if the final analysis results differed from those provided, an updated response would be provided. The analysis has now been completed, and the results differ slightly from the preliminary results provided. Enclosure 2 provides an updated response to RAI 4.3-15.

Please contact Mr. Darrel Turner, License Renewal Project Manager, at 269-764-2412, or Mr. Robert Vincent, License Renewal Licensing Lead, at 269-764-2559, if you require additional information.

Summary of Commitments

This letter contains no new commitments or changes to existing commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 28, 2005.

Paul A. Harden
Site Vice President, Palisades Nuclear Plant
Nuclear Management Company, LLC

A112

Enclosures (2)

CC Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC
License Renewal Project Manager, Palisades, USNRC

ENCLOSURE 1

NMC Responses to NRC Requests for Additional Information
Dated September 28, 2005

(11 pages)

RAI 4.5.2(a)

In response to RAI 4.5.2, the applicant provided an excerpt from its report entitled "30th Year Physical Tendon Surveillance of Palisades Nuclear Plant 2002," as Enclosure 4. In Section VIII of this enclosure (page 1 of the enclosure), the applicant stated that "as a result of the generator change and the re-tensioning of a large number of vertical tendons these must now be excluded from this analysis." The staff requests the applicant to explain:

a) When the generator change and re-tensioning of a large number of vertical tendons were done, and,

b) Since a large number of vertical tendons were excluded from the analysis, explain how the time-limited aging analysis (TLAA) for these excluded tendons is performed.

NMC Response to NRC RAI 4.5.2(a)

a) The steam generator replacement was completed in 1991; this outage occurred between the 15-year and 20-year surveillance.

b) As can be seen in the excerpt from the report entitled "30th Year Physical Tendon Surveillance of Palisades Nuclear Plant 2002," (See pages 8 and 10 of this enclosure) measurement of tendon liftoff force has been performed on previously de-tensioned and re-tensioned tendons. V72, V128, V126, V116, 48AE and 52AE were all re-tensioned during the steam generator replacement project. Since retensioning, these tendons have all been selected and tested during a subsequent surveillance (1992, 1997 or 2002). The surveillance test results for each of these tendons were acceptable (above the minimum required value). The tendons are excluded from the regression analysis solely because they have been previously de-tensioned and re-tensioned. They are not excluded from future testing under the Containment Inservice Inspection Program; this testing will assure the continued acceptability of these tendons in accordance with 10 CFR 54.21(c)(1)(iii).

RAI 4.5.2(b)

Based on the information provided in the response to RAI 4.5.2, the applicant is requested to explain how the 95% confidence curves provided in Enclosure 4 were established.

NMC Response to NRC RAI 4.5.2(b)

Response:

The following is a general description of the method used for determining the confidence interval in the tendon regression analyses from Agresti and Finlay[1]:

> Strength is a function of the average tension, so the confidence interval is for the average tension at a point in time. The confidence interval for the average tension at time "X" is
>
> $$\hat{Y} \pm t\hat{\sigma}\sqrt{\frac{1}{n}+\frac{\left(X-\overline{X}\right)^2}{\sum_i\left(X_i-\overline{X}\right)}}$$
>
> The confidence interval for the average is narrower than the confidence interval for an individual tendon. This happens because the average will be aggregated from many tendons, and many of those individual tendons will be lower than the average. For comparison, the confidence interval for an individual tendon is
>
> $$\hat{Y} \pm t\hat{\sigma}\sqrt{1+\frac{1}{n}+\frac{\left(X-\overline{X}\right)^2}{\sum_i\left(X_i-\overline{X}\right)}}$$
>
> In these formulas, t is a standard t-statistic with n-2 degrees of freedom.

The regression analysis for each group of tendons using the data from the last surveillance report has been revised to project out to 60 years. Plots have also been added with time on a logarithmic scale. The results for the vertical and horizontal regressions are slightly different from those previously reported due to the following corrections: The test results from tendon V334 were incorrectly excluded from the vertical data. The test results from tendon 84DF were incorrectly included in the horizontal data.

The analysis results and plots of dome, vertical and horizontal tendon projections out to 60 years are provided below. These pages supersede the corresponding pages (40, 41, 42, 45, 47, 48 and 50) of Enclosure 4 to NMC letter of July 25, 2005. This information demonstrates the adequacy of the time limited aging analysis for the containment tendons.

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[1] Agresti, A., Finlay, B., (1997). *Statistical Methods for the Social Sciences.* Upper Saddle River, New Jersey: Prentice-Hall.

ENGINEERING FILE NUMBER: 371

PRECISION SURVEILLANCE CORPORATION
3468 WATLING STREET
EAST CHICAGO, INDIANA 46312
PHONE: (219) 397-5826
FAX: (219) 397-5867

MAIN TITLE: 30TH YEAR TENDON SURVEILLANCE AT THE PALISADES NUCLEAR PLANT

SUB-TITLE: POST TENSIONING SURVEILLANCE REPORT

PREPARED BY: PAUL C. SMITH
REVIEWED BY: CHRISTOPHER E. COX, P.E.
APPROVED BY: RONALD D. HOUGH, P.E.

ENGINEERING DEPARTMENT

ABSTRACT

THIS REPORT PRESENTS THE FINDINGS OF THE THIRTIETH YEAR PHYSICAL TENDON SURVEILLANCE AT THE PALISADES NUCLEAR PLANT. BASED UPON THE DATE GATHERED AND REPORTED HEREIN, THE CONCLUSION IS REACHED THAT NO ABNORMAL DEGRADATION OF THE POST-TENSIONING SYSTEM HAS OCURRED IN THE PALISADES PLANT CONTAINMENT BUILDING

REVISION CONTROL LOG

REV	REVISION DATE	BY	APPROVED BY	PAGES AFFECTED
DRAFT	01-03			ALL
0	02-21-03			i-xii, 1-51, A1-A316, B1-B18, C1-C21, D1-D29, E1-E17, F1-F317, G1-G20
1	10-19-05	[signature]	R.D.H	40-42, 45, 47, 48, 50

30TH YEAR TENDON
SURVEILLANCE AT THE
PALISADES NUCLEAR PLANT

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VIII. COMPARISON WITH ORIGINAL INSTALLATION DATA

A comparison of the liftoff forces from this surveillance to the original installation lock-off forces is made in an effort to detect any evidence of system degradation. The lock-off forces are compared in order to detect any abnormal force loss which would possibly indicate an underestimation of the creep, shrinkage and/or elastic shortening effects in the Containment Building.

The losses for the tendon groups were found to be 15.76% for the dome tendons, 11.91% for the vertical tendons and 16.27% for the horizontal tendons. Based upon a comparison with the results from other facilities, these losses are less than has been experienced at younger containments and does not indicate any degradation of the system.

A regression analysis was conducted on each of the tendon groups and the graphs are shown on the following pages along with the input data for force, test dates and age (time stressed). All three analysis show each group remaining above the minimum requirements well beyond the next surveillance period. Projections to 40 years after installation (38 years of plant life) show a dome projection of 643 kips with a minimum requirement of 584 kips, vertical value of 666 kips against a minimum requirement of 615 kips and a horizontal projection of 647 kips against a minimum of 615 kips. As a result of the generator change and the retensioning of a large number of vertical tendons these must now be excluded from this analysis. This results in only two data points each for the Twentieth and Twenty-fifth year surveillances leading to a somewhat erratic forecast profile. With only two points to plot the projection does not have enough points to provide extensive indications of trend at this time. However, a review of losses for the vertical group do not give any indication of group deterioration and there is little doubt that the group will remain above minimum values throughout the next surveillance interval. Dome and horizontal tendons show forecast curves consistant with imput from a larger field of data and will also remain above minimum levels beyond the next surveillance.

A review of previous surveillance data indicated that the current common tendons used during this surveillance were in fact detensioned during the first surveillance and new tendons should be selected from a pool of tendons where only liftoffs were performed (fifteenth year surveillance onwards). In addition, earlier surveillances used the hammer method for evaluating the liftoff point although this should have a minimal effect on the regression analysis due to the reduced weighting of older data.

1 Changed info.

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30TH YEAR TENDON SURVEILLANCE AT THE PALISADES NUCLEAR PLANT

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TABLE XII: COMPARISON OF ORIGINAL LOCKOFF FORCES TO AS FOUND FORCES

TENDON	LIFTOFF FORCE		LOSS	PERCENTAGE	AVERAGE
	ORIGINAL	@ 30 YEARS	(kips)	%	PERCENTAGE
D1-18	780.0	657.2	122.8	15.74	15.76
D1-38	783.8	675.9	Detensioned first surveillance		
D2-43	776.25	654.8	121.45	15.65	
D3-20	783.75	659.25	124.5	15.89	
V-14	776.25	695	81.25	10.47	11.91 ⚠1
V-16	750.0	677.8	72.2	9.63	
V-30	780.0	664.7	115.3	14.78	
V-116	776.0	740.4	Retensioned at Generator Change		
V-302	761.25	669.1	92.15	12.11	
⚠1 V-334	781	682.9	98.1	12.56	
H-22AE	765.0	650.7	114.3	14.94	16.27
H-23BD	780.0	629.0	151.0	19.36	
H-24BD	750.0	610.3	139.7	18.63	
H-25BD	780.0	638.6	141.4	18.13	
H-62BF	780.0	660.8	119.2	15.28	
H-78CE	783.75	695.5	88.25	11.26	
H-84DF	772.5	662.5	Detensioned first surveillance		

⚠1 Changed info.

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PALISADES REGRESSION ANALYSIS

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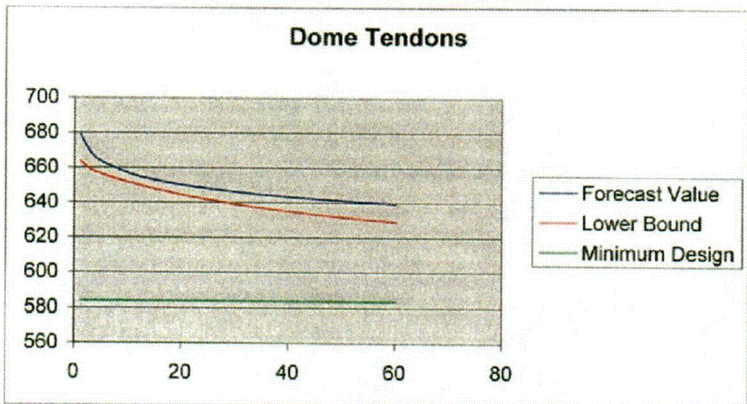
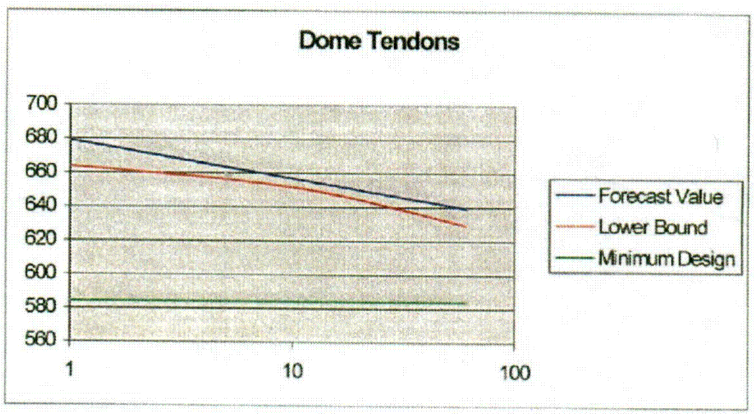
DOME TENDONS

Forecast Years	Forecast Value	Lower Bound
1	679	664
3	668	659
5	664	656
10	657	652
15	653	648
20	650	644
25	648	642
30	646	639
35	645	637
40	643	635
45	642	633
50	641	632
55	640	631
60	640	629





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PALISADES REGRESSION ANALYSIS

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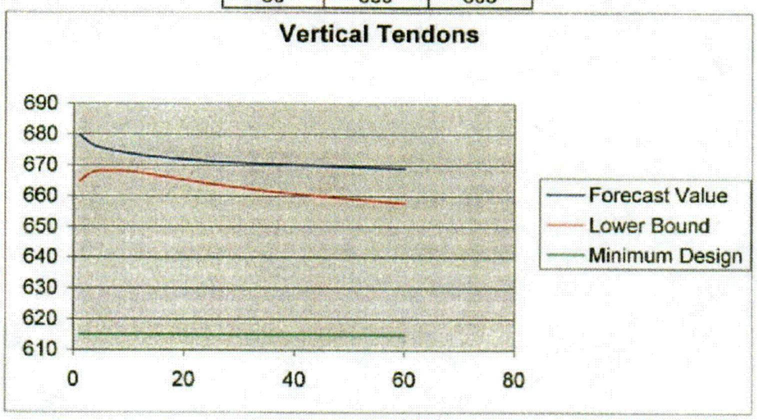
VERTICAL TENDONS

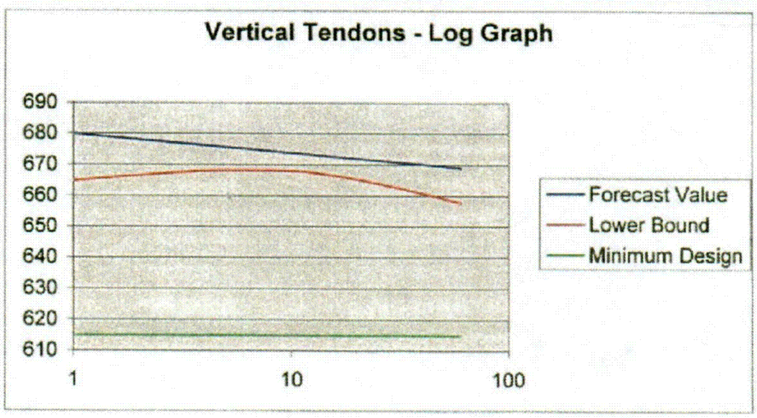
Rev 1.

Included V334 which is common tendon and was excluded in error.

Increases projection at 60 years by 3 kips or 0.45%.

Forecast Years	Forecast Value	Lower Bound
1	680	665
3	677	667
5	676	668
10	674	668
15	673	667
20	672	665
25	671	664
30	671	663
35	670	662
40	670	661
45	670	660
50	669	659
55	669	658
60	669	658





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30TH YEAR TENDON
SURVEILLANCE AT THE
PALISADES NUCLEAR PLANT

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REGRESSION ANALYSIS DATA

TENDON NUMBER	TENDON FORCE	TEST DATE	ORIGINAL STRESS	AGE (TIME STRESSED)
V20	659	2-21-92	9-5-69	22.47
V72	728 *	3-9-92	9-9-69	—
V128	680 *	2-21-92	9-3-69	—
V218	631	3-16-92	9-3-69	22.53
V26	691	9-15-97	9-2-69	28.04
V126	745 *	7-31-97	9-9-69	—
V248	665	9-8-97	9-5-69	28.01
1 V334	684.4	8-1-97	9-4-69	27.91
V14	695	8-21-02	9-5-69	32.96
V16	678	8-21-02	9-4-69	32.96
V30	665	8-20-02	9-9-69	32.95
V116	740 *	9-20-02	9-3-69	33.05
V302	669	9-20-02	9-3-69	33.05
1 V334	682.9	8-21-02	9-4-69	32.96

* RETENSIONED AFTER GENERATOR CHANGOUT THEREFORE EXCLUDED.

1 Rev 1. Information added

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PALISADES REGRESSION ANALYSIS

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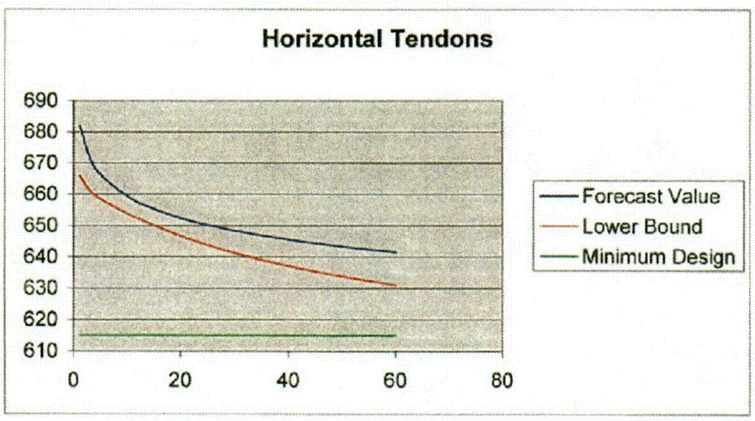
HORIZONTAL TENDONS

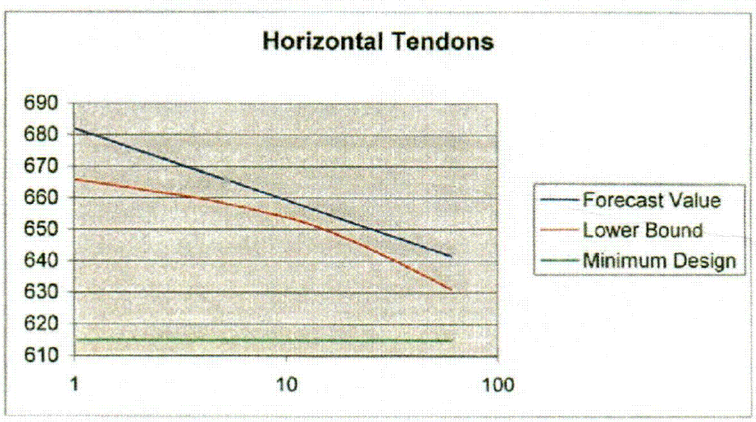
REV. 1.

Tendon 84DF result in 2002 removed from analysis as this tendon was detensioned in first surveillance.

Forecast drops by 1 kip (0.15%)

Forecast Years	Forecast Value	Lower Bound
1	682	666
3	671	661
5	666	658
10	659	654
15	655	650
20	652	647
25	650	644
30	648	641
35	647	639
40	646	637
45	644	635
50	643	634
55	642	632
60	642	631





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PSC Precision Surveillance Corporation

30TH YEAR TENDON
SURVEILLANCE AT THE
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REGRESSION ANALYSIS DATA

TENDON NUMBER	TENDON FORCE	TEST DATE	ORIGINAL STRESS	AGE (TIME STRESSED)
29AE	625	3-12-92	8-22-69	22.56
48AE	702 *	3-11-92	5-27-69	22.79
52AE	669 *	3-11-92	5-26-69	22.79
46BD	653	3-4-92	9-11-69	22.48
77BF	640	2-25-92	9-23-69	22.43
70DF	672	2-24-92	9-22-69	22.43
68AC	646	8-27-97	5-19-69	28.27
69AE	653	8-19-97	5-16-69	28.26
26BD	658	8-22-97	9-15-69	27.93
72BF	654	8-7-97	9-22-69	27.87
28DF	674	8-5-97	9-15-69	27.89
22AE	651	9-8-02	8-25-69	33.04
23BD	629	9-23-02	9-16-69	33.02
24BD	610	9-8-02	9-15-69	32.98
25BD	639	9-23-02	9-15-69	33.02
62BF	661	10-16-02	6-2-69	33.37
78CE	696	10-20-02	9-24-69	33.07
△1 84DF	EXCLUDED	9-6-02	9-23-69	32.95

* RETENSIONED DURING GENERATOR CHANGOUT THEREFORE EXCLUDED

△1 Rev 1. Information changed. 84DF detensioned during first surveillance and excluded

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RAI 4.5.3(a)

In response to RAI 4.5.3, the applicant provided a summary of the regression analysis data through tables and graphics in Enclosure 4. In the tables there are a number of tendons that appear to have been excluded from the analysis. These tendons are numbered as: D1-38, V334, and 65BF. The applicant is requested to provide the basis for exclusion of these tendons from the analysis.

NMC Response to NRC RAI 4.5.3(a)

Tendons D1-38 and 65BF were excluded because they were de-tensioned and re-tensioned during the first surveillance; therefore, any data after that time is excluded as unrepresentative of the general population.

Tendon V334 was incorrectly excluded from the analysis. Apparently, V334 was mistakenly identified as V324, which was de-tensioned and re-tensioned during the first surveillance. The regression analysis prepared in response to RAI 4.5.2(b) includes tendon V334.

It was also noted that tendon 84DF was de-tensioned and re-tensioned during the first surveillance, and should have been excluded, along with D1-38 and 65BF. The regression analysis prepared in response to RAI 4.5.2(b) excludes 84DF.

Enclosure 2

Updated NMC Response to NRC RAI 4.3-15

(2 Pages)

Original RAI 4.3-15 in NRC Letter Dated July 21, 2005

Section 4.3.14 indicates that Palisades has no shutdown cooling line inlet transition, and that the safety injection and shutdown cooling functions share a common nozzle. As an alternate location to the shutdown cooling line inlet transition, provide the highest CUF at this location which includes the effect of the reactor coolant system environment, or select an alternative high CUF location equivalent to the shutdown cooling line inlet transition.

NMC Updated Response to NRC RAI 4.3-15

The original NMC response to RAI 4.3-15, in a letter dated August 19, 2005, stated:

> Preliminary analysis results indicate that the limiting location in this area is at the end of the cladding near the safe end on the safety injection nozzle. This is the common nozzle that supports both safety injection and shutdown cooling. The fatigue usage factor at this location is 0.0308. After applying the environmental factor of 15.35 for stainless steel, the environmentally corrected usage factor is 0.472.
>
> The analysis which supports these values is in the process of being finalized. If these values change in the final, approved analysis, an updated response will be provided.

The final analysis has reached a different conclusion than reported in the above response. The fatigue usage factor and the environmentally corrected fatigue usage factors are accurate for the location reported above , but (1) the location evaluated is not the limiting location, and (2) because it is not a pressure boundary, the stainless steel cladding is not the material of concern for environmentally assisted fatigue.

The limiting location of concern occurs at the acute angle of the intersection at the inside surface of the safety injection nozzle and the inside surface of the primary coolant system pipe. The 60 year fatigue usage factor is 0.036. After applying the environmental factor of 1.79 for carbon steel, the environmentally corrected usage factor is 0.065.

The second most limiting location is at the opposite end of the safety injection nozzle at the extreme end of the safe end. The 60 year fatigue usage factor is 0.0097. After applying the environmental factor of 1.79 for carbon steel, the environmentally corrected usage factor is 0.017. Because this is the second most limiting location on this combined use nozzle, this value is assumed to correspond with the shutdown cooling line inlet transition.

It has also been determined, that the charging nozzle analysis used an excessively conservative environmental factor for the Alloy 600 material. The

correct value for Alloy 600 is 1.49 rather than the stainless steel value of 15.35 that was used.[2] Therefore, the cumulative usage factor for the charging inlet nozzle would not exceed 1.0 as stated in LRA Table 4.3.14-1 on page 4-40. Use of the correct F_{en} for the Alloy 600 material results in a CUF of 0.456 (0.306 X 1.49), significantly less than 1.0.

The updated analysis concludes that the fatigue usage factors at all NUREG/CR-6260 sample locations, including the effects of the reactor coolant environment, will remain less than 1.0 for the extended operating period.

[2] The F_{en} for Alloy 600 material comes from Chopra, Omesh K, "Status of Fatigue Issues at Argonne National Laboratory," presented at EPRI Conference on Operating Nuclear Power Plant Fatigue Issues & Resolutions, August 22-23, 1996.